WAIPAHU ESTATES SUBDIVISION UNIT II - PRELIMINARY SOIL REPORT
(for residential development)

WAIPIO, EWA, OAHU, HAWAII

TAX MAP KEY: 9-4-07: 9

To:
COMMUNITY PLANNING, INCORPORATED

By:
WALTER LUM ASSOCIATES, INCORPORATED
CIVIL, STRUCTURAL, SOILS ENGINEERS
December 26, 1969

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS

WALTER LUM
EDWARD WATANABE
EZRA KOIKE

3030 WAIALAE AVE., HONOLULU, HAWAII 96816 • TEL. 737-7931

December 26, 1969

COMMUNITY PLANNING, INC.
Suite 602, 810 Richards Street
Honolulu, Hawaii 96813

Gentlemen:

Subject: Waipahu Estates Subdivision Unit II
Preliminary Soil Report
(for residential development)
Waipio, Ewa, Oahu, Hawaii
Tax Map Key: 9-4-07: 9
Chapter 23, Revised Ordinances of Honolulu,
1961 As Amended

In accordance with your request, a preliminary soil exploration was made at the proposed residential development site for the Waipahu Estates Subdivision Unit II at Waipio, Ewa, Oahu, Hawaii.

From the field exploration and laboratory test results, it is our opinion that the site may be developed for residential housing. Houses can be supported either directly on stiff existing ground or on well constructed fills constructed from suitable on-site soils.

Unforeseen or undetected conditions such as soft spots or seepage water may occur in localized areas and will have to be adjusted and corrected in the field as they are detected.

All earthwork should be done in accordance with the requirements of Chapter 23, Revised Ordinances of Honolulu, 1961 As Amended and the recommendations contained herein.

The report includes a Boring Location Plan, boring logs, laboratory test results and recommendations.

Respectfully submitted,

WALTER LUM ASSOCIATES, INC.

Ezra Koike

Ezra Koike
Professional Engineer
Hawaii No. 1450

EK:vi

C O N T E N T S

WAIPAHU ESTATES SUBDIVISION UNIT II - PRELIMINARY SOIL REPORT
(for residential development)

WAIPIO, EWA, OAHU, HAWAII

TAX MAP KEY: 9-4-07: 9

SCOPE OF EXPLORATION

The purpose of this exploration was to determine general soil conditions of the proposed site, Waipahu Estates Subdivision Unit II at Ewa, Oahu, Hawaii, for residential development.

This report includes preliminary field exploration, laboratory tests and recommendations regarding the soils at the site.

PRELIMINARY FIELD EXPLORATION

Ten borings were made at the site. The locations of these borings and four borings made previously for Waipahu Estates Subdivision Unit I are shown on Figure 1, Boring Location Plan. Descriptions of the underlying soils encountered in the borings are shown on Boring Logs Nos. 1 thru 10. Also attached are the logs of four borings made for Waipahu Estates Subdivision Unit I.

Borings were made with 3-in. diameter augers with tungsten carbide drag bits. Soil samples were recovered with 2-in. thin wall tubes and standard split spoon samplers driven with a 140-lb hammer falling 30 inches.

Soil samples were visually identified and tentatively classified in the field. In the laboratory, they were subjected to appropriate tests. The field identifications and classifications were then reviewed and modified to conform with the results of the laboratory tests in accordance with the "Unified Soil Classification System."

LABORATORY TESTS

Laboratory tests included: natural density, water content and unconfined compression; Atterberg limits; specific gravity; gradation; AASHO T-180-57 density; expansion and CBR.

A list of the standard field and laboratory test methods used for this project is given in the Appendix.

A summary of the laboratory test results is given in Tables IA and IB.

GENERAL SITE AND SOIL CONDITIONS

The project site is located along the north side of the new Waipahu Street and west of Waipahu Estates Subdivision Unit I in Waipio, Ewa, Oahu, Hawaii.

The site is presently used as a sugar cane field.

The existing ground generally slopes down toward the south at about 3 to 14 percent grades with steeper sections in localized areas along the drainage-ways and cane haul roadways.

An unlined drainage ditch sloping downward from north to south ran along the eastern boundary of the site.

From the field exploration and laboratory test results, the soils encountered in the borings may be generally described as follows:

A surface layer about 2 to 4 ft of medium to stiff, reddish-brown clayey silt or brown clay underlain by stiff to very stiff brown clay and reddish-brown clayey silt with decomposed rocks to about 11 to 26 ft, the depths drilled.

Water was not noticed within the depths drilled during the field explorations.

For more detailed descriptions of soils encountered, refer to the boring logs.

DISCUSSION AND RECOMMENDATIONS

In general, the present plan is to use cut or fill slopes of less than about 15 ft in height. The proposed grading generally indicates fills of less than about 10 ft in thickness.

In the opinion of the Soil Engineer, the on-site soils, in general, have sufficient strength to support the fills and the light residential structures proposed, provided the site is cleared, grubbed and drained and soft spots are removed.

Unforeseen or undetected conditions such as soft spots or seepage water may occur in localized areas and will have to be adjusted and corrected in the field as they are detected.

Fills

In general, the on-site soils are suitable for the construction of the proposed fills. The construction of the proposed fills should be done as required by the F.H.A. Data Sheet 79-G; Revised Ordinances of Honolulu, 1961 As Amended; and as recommended below:

1. Topsoil and stockpiled soils should be either (a) stripped to stiff natural ground or (b) scarified and recompacted before the placement of fills.

2. All hard surfaces along existing access roads should be scarified down to stiff soils and recompacted to match the density of the surrounding soil.

3. Where fills are proposed, the bottom and the sides of the low spots and natural drainageways should be stripped down to stiff natural ground or scarified and recompacted before the placement of fills.

4. Subdrain lines with laterals in a herringbone pattern should be placed along natural drainageways before the placement of fills. The final locations of subdrains should be determined in the field after clearing and grubbing.

5. All fills should be constructed in approximately level layers starting at the lower end and working upward. Where fills are made on sloping areas steeper than about 5 horizontal to 1 vertical, the ground at the toe of the fill should be benched to a generally level condition. As the fill is brought up, it should be continually keyed into the stiff natural ground by cutting steps into the slopes and compacting the fill into these steps.

6. All fills should be laid in 6-in. compacted layers with a relative density of at least 90% of AASHO T-180-57 density.

Slopes

Cut and fill slopes of 2 horizontal to 1 vertical or flatter should be used.

Slope adjustments or other precautions may be necessary if seepage zones or soft spots are encountered in localized areas.

If slope heights (toe to top) of greater than 15 ft are considered, 8-ft-wide benches should be placed at height intervals of about 15 ft or less in both cuts and fills.

For protection against erosion during construction, it is recommended that runoff water from rainstorms be controlled by berms or other approved methods.

The surface of fill slopes should be compacted with a sheepsfoot roller or by cat-tracking.

Where slopes are cut thru rocky ground, all loose outcroppings should be removed. Loose pockets and hollow spots should be cleaned out and backfilled.

Slope planting is recommended on cut and fill slopes to minimize surface erosion.

Foundations

If earthwork is carried out as specified, the stiff natural ground and well constructed fills should develop adequate bearing values to support the proposed light residential structures.

For light one and two-story houses, differential settlements will probably be negligible and within the settlement tolerances of residential structures.

Recommendations for foundation construction are as follows:

1. For light residential structures, conventional type of house foundations such as slab-on-ground construction or post-and-beam construction may be used.

2. Bearing values for a given soil usually vary with the size and depth of the footings. For light residential structures, bearing values of 1500 p.s.f. on compacted fills and 2000 p.s.f. on stiff natural ground may be used.

3. Because of the downhill creep effect of soils on a slope, some settlement may occur near the tops of slopes. Therefore, for slopes of about 15 ft or higher, buildings should be placed about 15 ft from the tops of slopes. This distance may be reduced for lower slope heights, e.g., 10 ft for 10-ft-high slopes, but in no case closer than 5 ft from the top of a slope.

4. Construction of retaining walls on side slopes should be avoided unless the underlying materials are very stiff or hard.

5. Good surface drainage away from the foundation of the proposed structures should be maintained.

Roadways

In general, a rough estimate of the roadway pavement thickness for the light residential traffic anticipated is as follows:

1. Wearing course - 2-in. asphaltic concrete.
2. Base course - 6-in. base course over a prepared subgrade.

Provisions should be made in the contract documents to allow for local adjustments regarding subbase requirements in the field in accordance with the design standards of the City and County of Honolulu.

It is recommended that subgrades be compacted and shaped to drain. To avoid the ponding of water and softening of the subgrade at low points, weep holes should be placed at subgrade levels thru the walls of the catch basins which are placed in these low areas.

PROPOSED SPECIFICATION FOR EARTHWORK

WAIPAHU ESTATES SUBDIVISION UNIT II

General Description

This item shall consist of all clearing and grubbing, removing of existing structures, preparing of land to be filled, excavating and filling of the land, spreading, compacting and testing of the fill, and all subsidiary work necessary to complete the grading.

Clearing, Grubbing and Preparing Areas to be Filled

All vegetation and rubbish shall be removed and disposed of, leaving the disturbed area with a neat, debris-free appearance.

All vegetable matter shall be removed from the surface upon which fill is to be placed. All topsoil and stockpiled soils shall be (1) stripped to stiff natural ground or (2) scarified and recompacted before the placement of fills. All topsoil encountered at finish grade shall be scarified and recompacted.

All hard surfaces along the existing access roads shall be scarified down to stiff soils and recompacted to match the density of the surrounding soil before the placement of fills.

Where fills are proposed in all sidehill areas, gullies, and along drainage and irrigation ditches, all loose material along the bottom and the sides shall be stripped down to stiff natural ground before the placement of fills.

Subdrains and laterals shall be placed along the bottom and sides of natural drainageways before the construction of fills. The final locations of subdrains should be determined in the field after clearing and grubbing.

Where fills are made on sloping areas steeper than 5 horizontal to 1 vertical, the ground at the toe of the slope shall be benched to a generally level condition. As the fill is brought up, it shall be continually keyed into the stiff natural ground by the cutting of steps into the hillside and compacting the fill into these steps. Ground slopes which are flatter than 5 horizontal to 1 vertical shall be benched when considered necessary by the Soil Engineer.

Materials

Fill materials shall consist of on-site soils approved by the Soil Engineer and identified in the soil report accepted by the F.H.A. The soils shall contain no more than a trace of organic matter and no particles larger than 6 in. in diameter. Also, it shall contain no more than 40% gravel (#4 sieve to 3 in. sieve sizes) and no more than 10% cobbles larger than gravel and smaller than 6 in. in diameter. Fill material placed in the top 2 ft of fills shall contain no more than 30% gravel and any material larger than gravel.

Placing, Spreading and Compacting Fill Material

The selected fill material shall be placed in level layers which, when compacted, shall not exceed 6 inches. Each layer shall be spread evenly and thoroughly blade-mixed during the spreading to insure uniformity of material and moisture content within each layer.

No rocks or cobbles shall be allowed to nest and all voids between rocks must be carefully filled and compacted with small stones or earth.

When the moisture content of the fill material is below that specified by the Soil Engineer, water shall be added until the moisture content is as specified and assures a thorough bonding during the compacting process.

When the moisture content of the material is above that specified by the Soil Engineer, the fill material shall be aerated by blading or by other satisfactory methods until the moisture content is as specified.

After each layer has been placed, mixed and spread evenly, it shall be thoroughly compacted to not less than 90% of maximum density in accordance with AASHO Test No. T-180-57 or other comparable density tests. Compaction shall be with sheepsfoot rollers, multiple-wheel pneumatic-tired rollers or other acceptable rollers which shall be able to compact the fill to the specified density. Rolling shall be accomplished while the fill material is at the specified moisture content. The rolling of each layer shall be continuous over its entire area and the roller shall make sufficient passes to insure the obtainment of the desired density.

Field density tests shall be made by the Soil Engineer of the compaction of the fill. Where sheepsfoot rollers are used, the soil may be disturbed to a depth of several inches. Density readings shall be taken as often as necessary in the compacted material below the disturbed surface as determined by the Soil Engineer. When these readings indicate that the density of any layer of fill or portion thereof is below the required 90% density, that layer or portion shall be reworked until the required density has been obtained.

The fill operation shall be continued in 6-in. compacted layers, as specified above, until the fill has been brought to the finished slopes and grades as shown on the accepted plans.

Excavation

Suitable material from excavation shall be used in the fill and all unsuitable material from excavation shall be disposed of.

Unforeseen Conditions

If unforeseen or undetected soil conditions such as soft spots or seepage water are encountered during the field operations, corrective measures shall be made in the field as they are detected.

Rainy Weather

No fill material shall be placed, spread or rolled during unfavorable weather conditions. When the work is interrupted by heavy rain, fill operations shall not be resumed until field tests by the Soil Engineer indicate that the moisture content and density are as previously specified.

BORING LOGS

Symbols

Symbols used generally are in accordance with the Unified Soil Classification System.

Where a parenthesis "(MH)" is used, the soil sample was classified by visual observation of the sample recovered.

Where no parenthesis "MH" is used, the soil sample was classified from either the Atterberg limits or sieve analysis test results.

WALTER LUM ASSOCIATES

3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

Boring Log

PROJECT: WAIPAHU ESTATES SUBDIVISION-II
LOCATION: WAIPIO, EWA, OAHU, HAWAII
TMK: 9-4-07: 9

HAMMER:
Weight: 140#
Drop: 30"
SAMPLER: 2"S - 2" THIN WALL TUBE
2"SS - 2" STANDARD SPLIT SPOON

BORING NO. 1 Sheet No. _____ of _____
Driller: WALTER LUM ASSOC. Date: NOV. 17, 1969
Field Party: MAESHIRO, GLORY, WOODS
Type of Boring: AUGER (CONCORE A5JR.) Diam.: 3"
Elev.: 82'± * Datum: _____
Drill Bit: T.C. DRAG
Water Level: NOT NOTICED
Time: -
Date: 11-17-69

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Moist. Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Lab. Torvane Shear P.S.F.	PENETRATION DATA: Standard Penetration Test (Blows Per Foot 0 10 20 30 40) / 2" O.D. Thin Wall Tube Sampler (Blows/0.5')
	ELEV. = 82'± *	0								
(CL-ML)	STIFF, BROWN CLAY		2"S	I-A	131	30	100	8010	830	5/.5' 11/.5'
(CL-ML)	VERY STIFF, BROWN CLAY	5	2"S	I-B	122	26	97	>13,000	>1800	4/.5' 13/.5'
CH	STIFF TO VERY STIFF, TAN-GRAY CLAY	10	2"SS	I-C	-	29	-	-	-	
(MH)	VERY STIFF, BROWN SILTY CLAY	15	2"SS	I-D	-	31	-	-	-	
	END OF BORING @ 20.5'	20	2"SS	I-E	-	28	-	-	-	44/.5'

*ELEVATION ESTIMATED FROM TOPO MAP.

WALTER LUM ASSOCIATES

3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

Boring Log

PROJECT: WAIPAHU ESTATES SUBDIVISION-II
LOCATION: WAIPIO, EWA, OAHU, HAWAII
TMK: 9-4-07: 9

HAMMER:
Weight: 140#
Drop: 30"
SAMPLER: 2"SS - 2" O.D. THIN WALL TUBE
2"SS - 2" STANDARD SPLIT SPOON

BORING NO. 2 Sheet No. _____ of _____
Driller: WALTER LUM ASSOC. Date: NOV. 18, 1969
Field Party: MAESHIRO, WOODS, GLORY
Type of Boring: AUGER (CONCORE) AS-JR. Diam.: 3"
Elev.: 89'± * Datum: _____
Drill Bit: T.C. DRAG

Water Level	NOT NOTICED				
Time	-				
Date	11-18-69				

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Moist. Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Lab. Torvane Shear P.S.F.	PENETRATION DATA: STANARD PENETRATION TEST Blows Per Foot (0 10 20 30 40)	PENETRATION DATA: 2" O.D. THIN WALL TUBE SAMPLER BLOWS/0.5'
	ELEV. = 89'± *	0									
CL	MEDIUM TO STIFF BROWN, CLAYEY SILT		2"S	2-A	104	32	79	5460	820		5/.5' 8/.5'
		5	2"S	2-B	119	30	91	5250	750		4/.5' 6/.5'
(ML)	VERY STIFF, BROWN CLAYEY SILT	10	2"SS	2-C	-	30	-	-	-		40/.5'
(ML)	VERY STIFF, BROWN CLAYEY SILT W/ TRACES OF DECOMPOSED ROCK	15	2"SS	2-D	-	35	-	-	-		45/.5'
		20	2"SS	2-E	-	35	-	-	-		30/.5'
	END OF BORING @ 21'										

*ELEVATION ESTIMATED FROM TOPO MAP.

WALTER LUM ASSOCIATES

3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 •

Boring Log

PROJECT: WAIPAHU ESTATES SUBDIVISION-II
LOCATION: WAIPIO, EWA, OAHU, HAWAII
TMK: 9-4-07 : 9

HAMMER:
Weight: 140#
Drop: 30"
SAMPLER: 2"S - 2" O.D. THIN WALL TUBE
2"SS - 2" STANDARD SPLIT SPOON

BORING NO. 3 Sheet No. ____ of ____
Driller: WALTER LUM ASSOC. Date: NOV. 25, 1969
Field Party: MAESHIRO, WOODS, LUNING
Type of Boring: AUGER (MOBILE MINUTEMAN) Diam.: 3"
Elev.: 76'± * Datum: ____
Drill Bit: T.C. DRAG

Water Level	NOT NOTICED				
Time	-				
Date	11-25-69				

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Moist. Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Lab. Torvane Shear P.S.F.	PENETRATION DATA: STANDARD PENETRATION TEST (Blows Per Foot 0 10 20 30 40)	PENETRATION DATA: 2" O.D. THIN WALL TUBE SAMPLER (BLOWS/0.5')
	ELEV. = 76'± *	0									
(MH-ML)	STIFF, REDDISH BROWN CLAYEY SILT		2"S	3-A	105	22	81	-	-		8/.5'
(ML)	STIFF, LIGHT BROWN w/ GRAY, CLAYEY SILT	5	2"S	3-B	112	29	87	-	-		8/.5' 13/.5'
ML	VERY STIFF, REDDISH BROWN, CLAYEY SILT w/ SOME SAND	10	2"SS	3-C	-	38	-	-	-		57/.5'
(MH)	VERY STIFF, REDDISH BROWN, CLAYEY SILT	15	2"SS	3-D	-	37	-	-	-		55
(MH)	VERY STIFF, REDDISH BROWN, CLAYEY SILT w/ DECOMPOSED ROCK	20	2"SS	3-E	-	34	-	-	-		40/.5'
	END OF BORING @ 21'										

*ELEVATION ESTIMATED FROM TOPO MAP.

WALTER LUM ASSOCIATES

3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

Boring Log

PROJECT: WAIPAHU ESTATES SUBDIVISION-II
LOCATION: WAIPIO, EWA, OAHU, HAWAII
TMK: 9-4-07: 9

HAMMER:
Weight: 140#
Drop: 30"
SAMPLER: 2"S - 2" O.D. THIN WALL TUBE
2"SS - 2" STANDARD SPLIT SPOON

BORING NO. 4 Sheet No. _____ of _____
Driller: WALTER LUM ASSOC. Date: NOV. 21, 1969
Field Party: MAESHIRO, LUNING, HASHIDA
Type of Boring: AUGER (MOBILE MINUTEMAN) Diam.: 3"
Elev.: 73'± * Datum: _____
Drill Bit: T.C. DRAG
Water Level: NOT NOTICED
Time: -
Date: 11-21-69

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Moist. Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Lab. Torvane Shear P.S.F.	PENETRATION DATA: STANDARD PENETRATION TEST (Blows Per Foot 0 10 20 30 40)	PENETRATION DATA: 2" O.D. THIN WALL TUBE SAMPLER (BLOWS/0.5')
	ELEV. = 73'± *	0									
(CL)	MEDIUM, BROWN CLAY		2"S	4-A	113	32	86	3020	600		3/5 3/5
		5	2"S	4-B	117	35	87	1920	560		3/5 4/5
(CL)	STIFF BROWN CLAY	10	2"SS	4-C	-	29	-	-	-		
		15	2"SS	4-D	-	27	-	-	-		
(ML)	VERY STIFF, BROWN CLAYEY SILT	20	2"SS	4-E	-	26	-	-	-		40/5
	END OF BORING @ 20.5'										

* ELEVATION ESTIMATED FROM TOPO MAP.

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WALTER LUM ASSOCIATES

3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 •

Boring Log

PROJECT: WAIPAHU ESTATES SUBDIVISION-II
LOCATION: WAIPIO, EWA, OAHU, HAWAII
TMK: 9-4-07: 9

HAMMER:
Weight: 140#
Drop: 30"
SAMPLER: 2" S - 2" O.D. THIN WALL TUBE
2" SS - 2" STANDARD SPLIT SPOON

BORING NO. 5 Sheet No. ____ of ____
Driller: WALTER LUM ASSOC. Date: DEC. 2, 1969
Field Party: MAESHIRO, HASHIDA
Type of Boring: AUGER (MOBILE MINUTEMAN) Diam.: 3"
Elev.: 83'± * Datum: ____
Drill Bit: T.C. DRAG

Water Level	NOT NOTICED				
Time	-				
Date	12-2-69				

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Moist. Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Lab. Torvane Shear P.S.F.	PENETRATION DATA: STANDARD PENETRATION TEST, Blows Per Foot (0 10 20 30 40)	PENETRATION DATA: 2" O.D. THIN WALL TUBE SAMPLER, BLOWS/0.5'
	ELEV. = 83'± *	0									
CL	STIFF, BROWN CLAY		2"S	5-A	134	19	112	7070			4/.5' 6/.5'
(CL)	MEDIUM, BROWN CLAY	5	2"S	5-B	124	30	96	3740	920		2/.5 4/.5'
		10	2"SS	5-C	-	27	-	-			23/.5'
CH	VERY STIFF, BROWN CLAY	15	2"SS	5-D	-	30	-	-	-		20/.5'
		20	2"SS	5-E	-	28	-	-	-		35/.5'
	END OF BORING @ 21'										

*ELEVATION ESTIMATED FROM TOPO MAP.

WALTER LUM ASSOCIATES

3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 •

Boring Log

PROJECT: WAIPAHU ESTATES SUBDIVISION - II

LOCATION: WAIPIO, EWA, OAHU, HAWAII

TMK: 9-4-07 : 9

HAMMER:
Weight: 140 #
Drop: 30"

SAMPLER: 2"SS - 2" STANDARD SPLIT SPOON
2"S - 2" O.D. THIN WALL TUBE

BORING NO. 6 Sheet No. _____ of _____

Driller: WALTER LUM ASSOC. Date: DEC. 3, 1969

Field Party: MAESHIRO, HASHIDA

Type of Boring: AUGER (MOBILE MINUTEMAN) Diam.: 3"

Elev.: 61'± * Datum: _____

Drill Bit: T.C. DRAG

Water Level	NOT NOTICED				
Time	-				
Date	12-3-69				

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Moist. Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Lab. Torvane Shear P.S.F.	PENETRATION DATA: STANDARD PENETRATION TEST Blows Per Foot (0 10 20 30 40)	PENETRATION DATA: 2" O.D. THIN WALL TUBE SAMPLER BLOWS/0.5'
	ELEV. = 61'± *	0									
(ML-CL)	MEDIUM, BROWN CLAY		2"S	6-A	114	6.1	107	-	-		3/5' 4/5'
(MH)	STIFF, BROWN CLAYEY SILT	5	2"S	6-B	117	25	94	6340	-		9/5' 10/5'
		10	2"SS	6-C	-	42	-	-	-		
(MH)	VERY STIFF, BROWN CLAYEY SILT W/ DECOMPOSED ROCK	15	2"SS	6-D	-	48	-	-	-		
		20	2"SS	6-E	-	49	-	-	-		
	END OF BORING @ 21.5'										

* ELEVATION ESTIMATED FROM TOPO MAP

WALTER LUM ASSOCIATES

3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

Boring Log

PROJECT: WAIPAHU ESTATES SUBDIVISION-II
LOCATION: WAIPIO, EWA, OAHU, HAWAII
TMK: 9-4-07 : 9

HAMMER:
Weight: 140#
Drop: 30"
SAMPLER: 2"S - 2" O.D. THIN WALL TUBE
2"SS - 2" STANDARD SPLIT SPOON

BORING NO. 7 Sheet No. _____ of _____
Driller: WALTER LUM ASSOC. Date: NOV. 28, 1969
Field Party: WOODS, MAESHIRO
Type of Boring: AUGER (MOBILE MINUTEMAN) Diam.: 3"
Elev.: 65'± * Datum: _____
Drill Bit: T.C. DRAG

Water Level				
Time	-			
Date	11-28-69			

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Moist. Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Lab. Torvane Shear P.S.F.	PENETRATION DATA: STANDARD PENETRATION TEST Blows Per Foot (0 10 20 30 40)	PENETRATION DATA: 2" O.D. THIN WALL TUBE SAMPLER BLOWS/0.5'
	ELEV. = 65'± *	0									
(CL-ML)	MEDIUM TO STIFF, BROWN, CLAYEY SILT		2"S	7-A	113	31	86	7440	1200		4/.5 4/.5
(CH)	STIFF, GRAY BROWN, CLAY	5	2"S	7-B	123	30	93	3070	1700		5/.5 8/.5
(CL-ML)	STIFF BROWN-GRAY CLAYEY SILT W/ DECOMPOSED ROCK & SAND	10	2"SS	7-C	-	38	-	-	-		
(CH-MH)	VERY STIFF GRAY BROWN, SILTY CLAY W/ TRACES OF DECOMPOSED ROCK	15	2"SS	7-D	-	39	-	-	-		
	END OF BORING @ 21.5'	20	2"SS	7-E	-	38	-	-	-		

*ELEVATION ESTIMATED FROM TOPO MAP

WALTER LUM ASSOCIATES — 3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 •

Boring Log

PROJECT: WAIPAHU ESTATES SUBDIVISION-II
LOCATION: WAIPIO, EWA, OAHU, HAWAII
TMK: 9-4-07 : 9

HAMMER:
Weight:
Drop:
SAMPLER: 2"S - 2" O.D. THIN WALL TUBE; 2"SS - 2" STANDARD SPLIT SPOON

BORING NO. 8 Sheet No. ____ of ____
Driller: WALTER LUM ASSOC. Date: DEC. 1, 1969
Field Party: MAESHIRO, HASHIDA
Type of Boring: AUGER (MOBILE MINUTEMAN) Diam.: 3"
Elev.: 72' ± * Datum:
Drill Bit: T.C. DRAG
Water Level: NOT NOTICED
Time: -
Date: 12-1-69

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Moist. Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Lab. Torvane Shear P.S.F.	PENETRATION DATA: STANDARD PENETRATION TEST, Blows Per Foot (0 10 20 30 40)	PENETRATION DATA: 2" O.D. THIN WALL TUBE SAMPLER, BLOWS/0.5'
	ELEV. = 72' ± *	0									
(CL)	MEDIUM TO STIFF, BROWN, CLAY		2"S	B-A	93	28	73	3640	-		4/.5' 5/.5'
		5	2"S	B-B	120	42	85	2290 6810	1570 1620		3/.5' 6/.5'
(ML)	STIFF, BROWN, CLAYEY SILT W/TRACES OF DECOMPOSED ROCK	10	2"SS	B-C	-	39	-	-	-		
(MH)	VERY STIFF, GRAY BROWN, CLAYEY SILT W/ DECOMPOSED ROCK	15	2"SS	B-D	-	39	-	-	-		
	END OF BORING @ 21.5'	20	2"SS	B-E	-	41	-	-	-		

*ELEVATION ESTIMATED FROM TOPO MAP.

WALTER LUM ASSOCIATES

3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

Boring Log

PROJECT: WAIPAHU ESTATES SUBDIVISION-II
LOCATION: WAIPIO, EWA, OAHU, HAWAII
TMK: 9-4-07: 9

HAMMER:
Weight: 140 #
Drop: 30"
SAMPLER: 2"ϕ - 2" O.D. THIN WALL TUBE; 2"ϕϕ - 2" STANDARD SPLIT SPOON

BORING NO. 9 Sheet No. _____ of _____
Driller: WALTER LUM ASSOC. Date: NOV. 26, 1969
Field Party: MAESHIRO, HASHIDA, WOODS
Type of Boring: AUGER (MOBILE MINUTEMAN) Diam.: 3"
Elev.: 50'± * Datum: _____
Drill Bit: T.C. DRAG

Water Level	NOT NOTICED			
Time	-			
Date	11-26-69			

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Moist. Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Lab. Torvane Shear P.S.F.	PENETRATION DATA: STANDARD PENETRATION TEST, Blows Per Foot (0 10 20 30 40)
	ELEV. = 50'± *	0								
(MH)	STIFF, BROWN CLAYEY SILT		2"ϕ	9-A	105	28	82	7800	-	4/.5' 7/.5'
		5	2"ϕ	9-B	113	32	86	4520	1200	3/.5' 4/.5'
MH	MEDIUM TO STIFF, BROWN, CLAYEY SILT									
		10	2"ϕϕ	9-C	-	37	-	-	-	
		15	2"ϕϕ	9-D	-	36	-	-	-	
ML	STIFF, BROWN, CLAYEY SILT W/ TRACES OF DECOMPOSED ROCK									
		20	2"ϕϕ	9-E	-	38	-	-	-	
	END OF BORING @ 21.5'									

*ELEVATION ESTIMATED FROM TOPO MAP.

WALTER LUM ASSOCIATES

3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

Boring Log

PROJECT: WAIPAHU ESTATES SUBDIVISION-II
LOCATION: WAIPIO, EWA, OAHU, HAWAII
TMK: 9-4-07: 9

HAMMER:
Weight: 140#
Drop: 30"
SAMPLER: 2"S - 2" O.D. THIN WALL TUBE
2"SS - 2" STANDARD SPLIT SPOON

BORING NO. 10 Sheet No. _____ of _____
Driller: WALTER LUM ASSOC. Date: NOV. 19, 1969
Field Party: GLORY, MAESHIRO, HASHIDA
Type of Boring: AUGER (MOBILE MINUTEMAN) Diam.: 3"
Elev.: 57'± * Datum: _____
Drill Bit: T.C. DRAG

Water Level				
Time	-			
Date	11-19-69			

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Moist. Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Lab. Torvane Shear P.S.F.	PENETRATION DATA: STANDARD PENETRATION TEST Blows Per Foot (0 10 20 30 40)	PENETRATION DATA: 2" O.D. THIN WALL TUBE SAMPLER BLOWS/0.5'
	ELEV. = 57'± *	0									
ML	STIFF, BROWN SILTY CLAY		2"S	10-A	116	30	89	4890	-		2/.5' 5/.5'
(ML)	VERY STIFF, BROWN SILTY CLAY	5	2"S	10-B	114	38	82	3120	-		8/.5' 12/.5'
		10	2"SS	10-C	-	39	-	-	-		
(MH)	VERY STIFF, REDDISH BROWN, CLAYEY SILT W/ TRACES OF DECOMP. ROCK	15	2"SS	10-D	-	47	-	-	-		
		20	2"SS	10-E	-	47	-	-	-		
		25	2"SS	10-F	-	36	-	-	-		
	END OF BORING @ 26.5'										

*ELEVATION ESTIMATED FOR TOPO MAP.

WAIPAHU ESTATES SUBDIVISION - II

TABLE I A - SUMMARY OF LABORATORY TEST RESULTS

BORING NO.	1	2	3	5	5
SAMPLE NO.	C		C	A	C
DEPTH BELOW SURFACE	10.0'-11.5'	SURFACE	10.0'-11.5'	1.0'-2.0'	10.0'-11.0
DESCRIPTION	TAN-GRAY CLAY	BROWN CLAY W/ SAND	REDDISH BROWN CLAYEY SILT W/ SOME SAND	BROWN CLAY	BROWN CLAY
GRADING ANALYSIS (% Passing)					
Sieve					
1"		100			
½"		97.8			
#4		89.7			
#10		85.1			
#20		80.2			
#40		75.7			
#100		70.9			
#200		69.0			
ATTERBERG LIMITS					
Air Dried or Natural	NATURAL	NATURAL	NATURAL	NATURAL	NATURAL
Liquid Limit	81	45	41	48	70
Plastic Limit	29	24	34	25	32
Plasticity Index	52	21	7	23	38
Dilatancy	NONE	SLOW-MED.	QUICK	VERY SLOW	NONE
Toughness	HIGH	MEDIUM	SLIGHT	MEDIUM	HIGH
Dry Strength	HIGH	MEDIUM	SLIGHT	MEDIUM	HIGH
UNIFIED SOIL CLASSIFICATION	CH	CL	ML	CL	CH
SPECIFIC GRAVITY		2.87			
EXPANSION AND CBR TESTS (Surcharge-51 P.S.F.)					
Molding Moisture Content, %		18.8			
Molding Dry Density, P.C.F.		108.8			
Swell upon saturation, %		0.6			
CBR at 0.1" Penetration		33.5			
COMPACTION TEST (AASHO T-180-57 Method ___)		A			
Dry to Wet or Wet to Dry		DRY TO WET			
Max. Dry Density (P.C.F.)		111.2			
Optimum Moisture (%)		20.0			

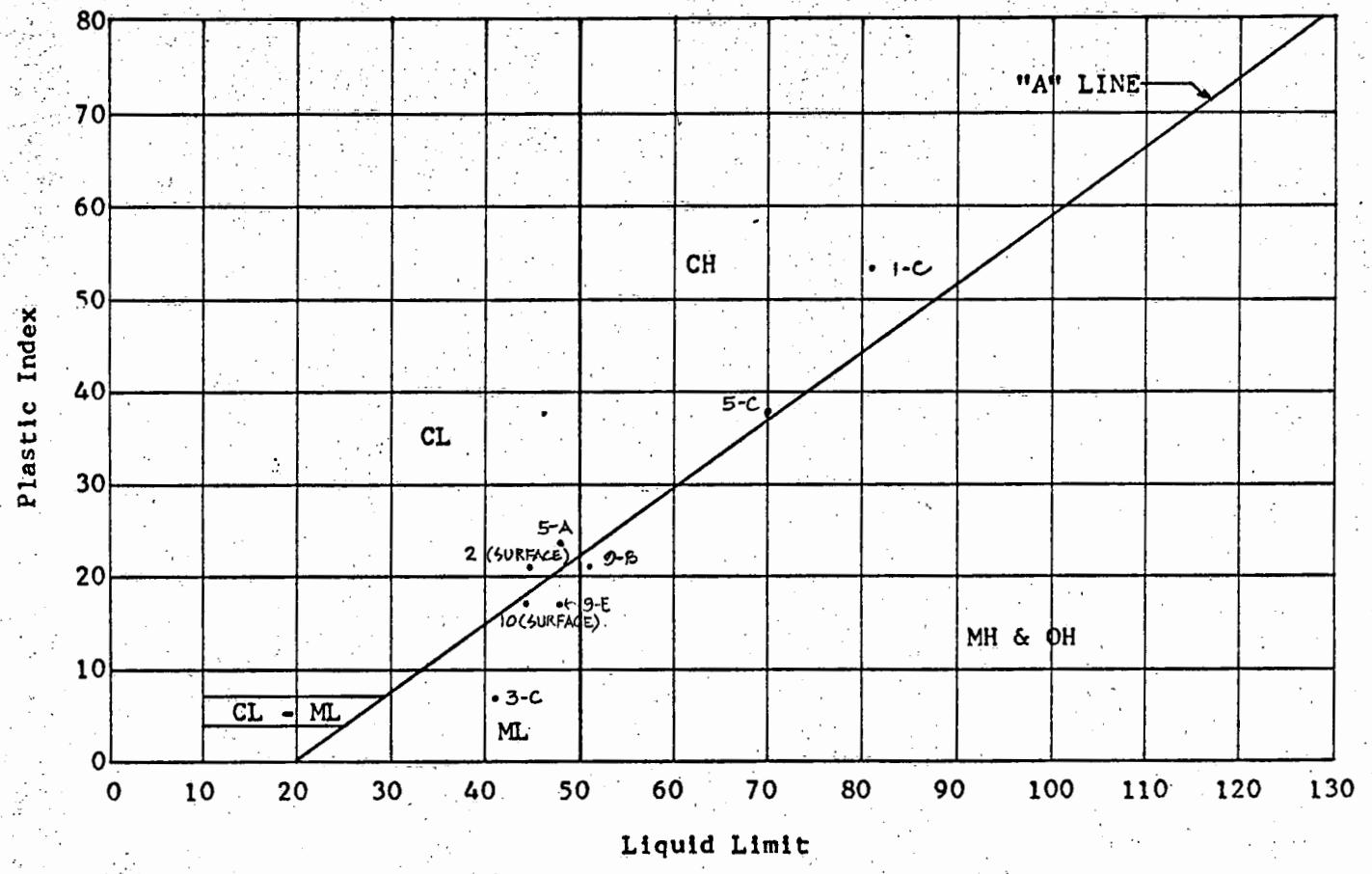
WAIPAHU ESTATES SUBDIVISION - II

TABLE I B - SUMMARY OF LABORATORY TEST RESULTS

BORING NO.	9	9	10		
SAMPLE NO.	B	E			
DEPTH BELOW SURFACE	5.0'-6.0'	20'-21.5'	SURFACE		
DESCRIPTION	BROWN CLAYEY SILT	BROWN CLAYEY SILT W/TRACES OF DECOMPOSED ROCK	BROWN SILTY CLAY		
GRADING ANALYSIS (% Passing) Sieve					
1"					
½"					
#4					
#10					
#20					
#40					
#100					
#200					
ATTERBERG LIMITS					
Air Dried or Natural	NATURAL	NATURAL	NATURAL		
Liquid Limit	51	48	44		
Plastic Limit	30	31	27		
Plasticity Index	21	17	17		
Dilatancy	NONE	VERY SLOW	SLOW		
Toughness	MED.-HIGH	MEDIUM	MEDIUM		
Dry Strength	MEDIUM	MEDIUM	MEDIUM		
UNIFIED SOIL CLASSIFICATION	MH	MH	ML		
SPECIFIC GRAVITY					
EXPANSION AND CBR TESTS (Surcharge-51 P.S.F.)					
Molding Moisture Content, %			24.0		
Molding Dry Density, P.C.F.			103.5		
Swell upon saturation, %			2.3		
CBR at 0.1" Penetration			30.7		
COMPACTION TEST (AASHO T-180-57 Method ___)			A		
Dry to Wet or Wet to Dry			DRY TO WET		
Max. Dry Density (P.C.F.)			103.8		
Optimum Moisture (%)			24.0		

JOB: WAIPAHU ESTATES SUBDIVISION - II

LOCATION: WAIPIO, EWA, OAHU, HAWAII

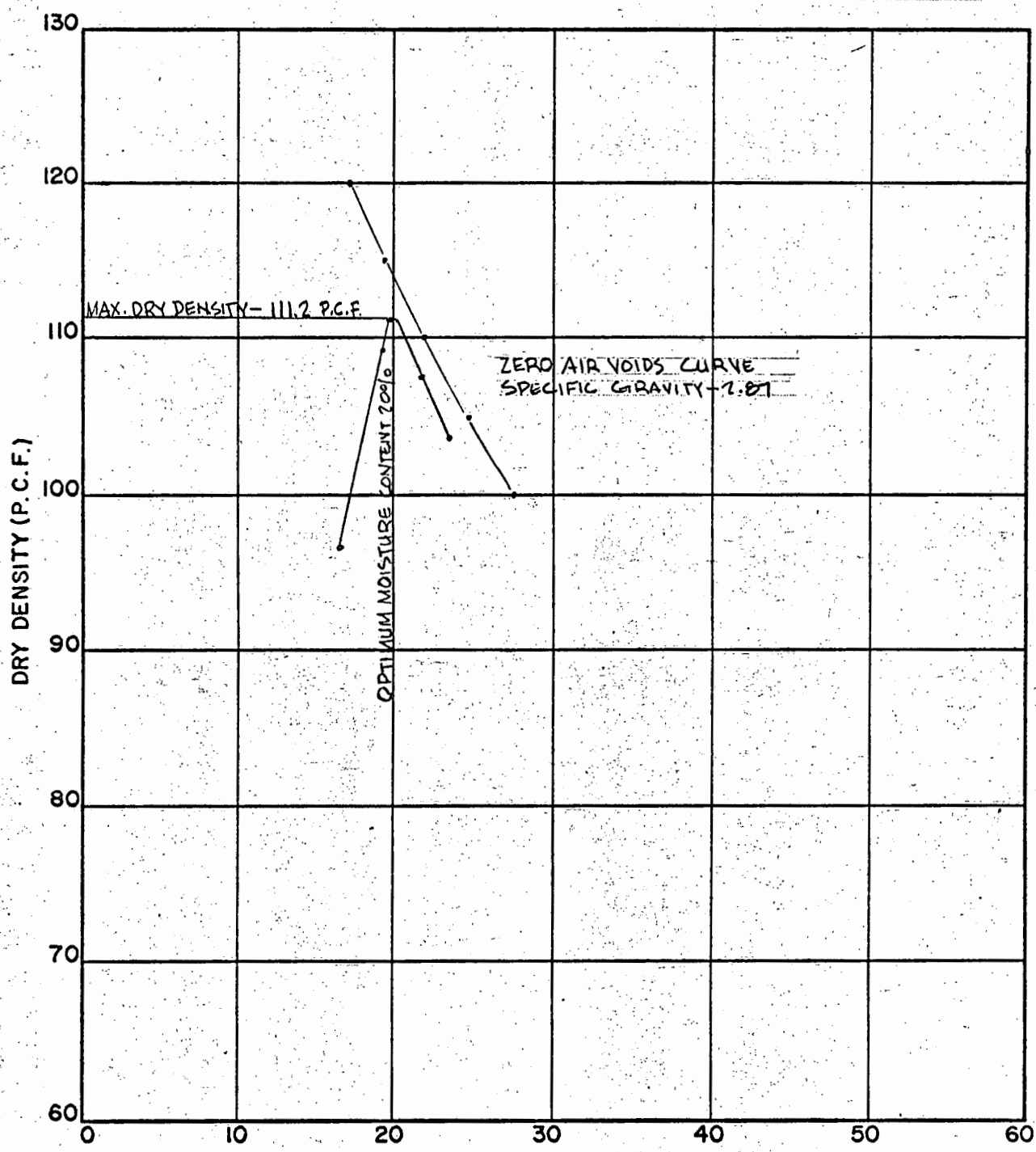


PLASTICITY CHART

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS

MOISTURE-DENSITY CURVE (AASHO T-180-57, METHOD A)

PROJECT: WAIPAHU ESTATES SUBDIVISION - UNIT II
LOCATION: WAIPIO, EWA, OAHU, HAWAII
SAMPLE NO: 2 (SURFACE)
SAMPLE DESCRIPTION: BROWN CLAY WITH SAND

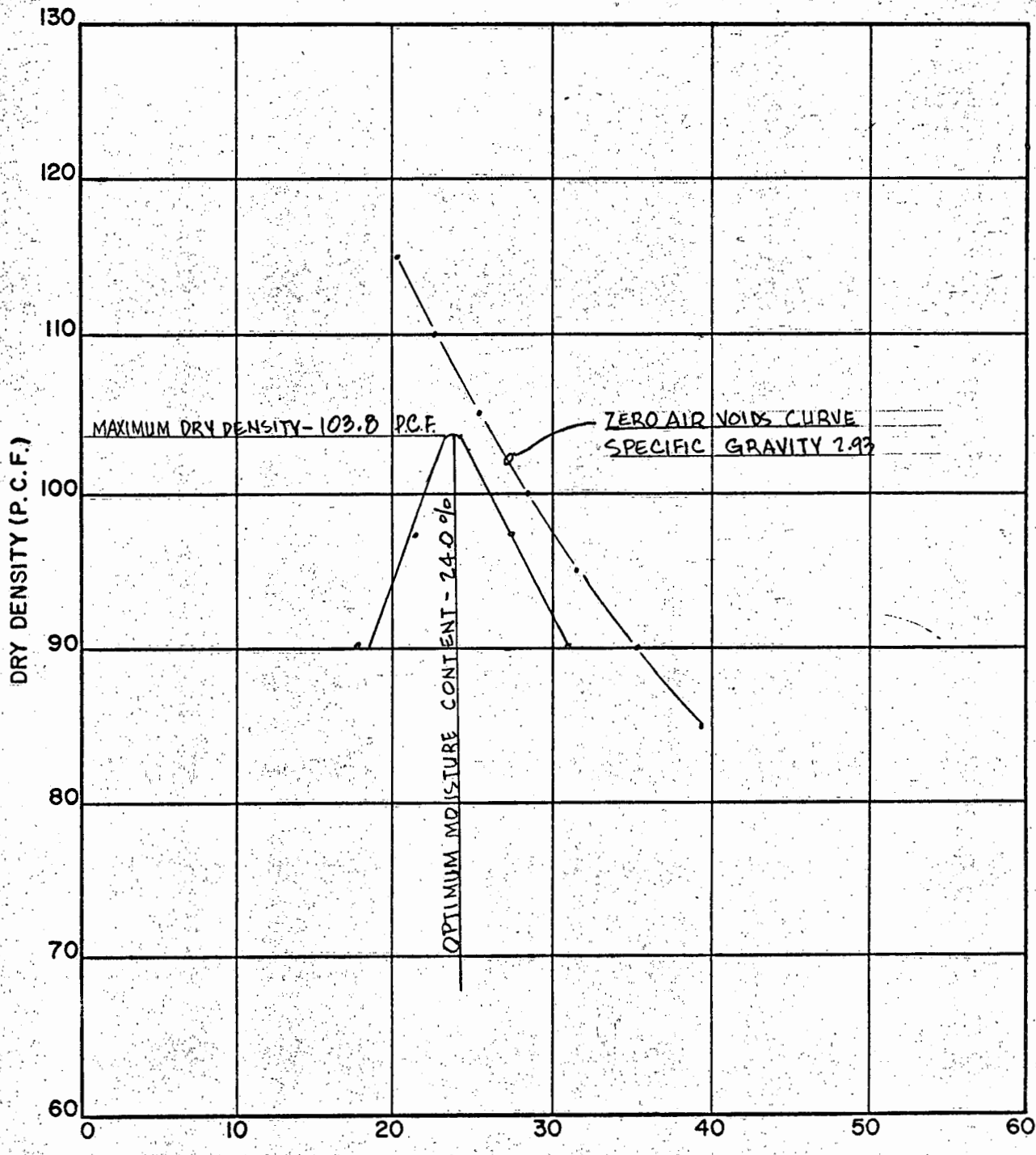


WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS

BY S.T. DATE 12-10-69

MOISTURE-DENSITY CURVE (AASHO T-180-57, METHOD A)

PROJECT: WAIPAHU ESTATES SUBDIVISION - UNIT II
LOCATION: WAIPIO, EWA, OAHU, HAWAII
SAMPLE NO: 10 (SURFACE)
SAMPLE DESCRIPTION: BROWN SILTY CLAY



WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS

BY S.T. DATE 12.6.69

LOGS OF BORINGS

FROM

WAIPAHU ESTATES SUBDIVISION UNIT I

WALTER LUM ASSOCIATES

3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 777-931

Boring Log

PROJECT WAIPAHU ESTATES SUBDIVISION UNIT 1

LOCATION WAIPIO, EWA, OAHU, HAWAII

T.M.K. : 9-4-07 : 9

HAMMER:

Weight 10-LB. SLEDGE HAMMER

Drop

SAMPLER: 2" STANDARD SPLIT SPOON

BORING NO. 1 Sheet No. ____ of ____

Driller WALTER LUM ASSOC. Date JAN. 16, 1969

Field Party PA, MOENOA

Type of Boring AUGER (MOBILE MINUTEMAN) Diam. 3"

Elev. 71' ± * Datum

Drill Bit T.C. DRAG BIT

Water Level NOT NOTICED

Time —

Date 1-16-69

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Elev.	Sample No.	Wet Dens. P.C.F.	Moist. Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: 2" STANDARD SPLIT SPOON W/ 10# HAMMER — Blows Per Foot (0 10 20 30 40)
	ELEV. = 71' ± *	0								
(ML)	VERY STIFF, BROWN CLAYEY SILT									
(ML)	STIFF, REDDISH BROWN CLAYEY SILT	5		I-A	-	34	-	-	-	16/5' 23/5'
		10		I-B	-	35	-	-	-	50/5'
(MH)	VERY STIFF, REDDISH BROWN-GRAY CLAYEY SILT	15		I-C	-	44	-	-	-	46/5
	END OF BORING @ 15.5'									

*ELEVATION ESTIMATED FROM TOPO MAP.

WALTER LUM ASSOCIATES

3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 777-931

Boring Log

PROJECT: WAIPAHU ESTATES SUBDIVISION UNIT 1
LOCATION: WAIPIO, EWA, OAHU, HAWAII
T.M.K. : 9-4-07 : 9

HAMMER:
Weight: 10# SLEDGE HAMMER
Drop:
SAMPLER: 2" STANDARD SPLIT SPOON

BORING NO. 5 Sheet No. ____ of ____
Driller: WALTER LUM ASSOC. Date: JAN. 17, 1969
Field Party: PA, MOENOA
Type of Boring: AUGER (MOBILE MINUTEMAN) Diam.: 3"
Elev.: 52' ± * Datum:
Drill Bit: FINGER TYPE BIT

Water Level				
Time	—			
Date	1-17-69			

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Elev.	Sample No.	Wet Dens. P.C.F.	Moist. Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: 2" STANDARD SPLIT SPOON w/ 10# HAMMER Blows Per Foot (0 10 20 30 40)
	ELEV. = 52' ± *	0								
(ML)	LOOSE TO MEDIUM BROWN, CLAYEY SILT									
(ML)	MEDIUM, BROWN CLAYEY SILT	5		5-A	-	40	-	-	-	5/5 5/5 4/5
		10		5-B	-	33	-	-	-	4 5/5
(ML)	VERY STIFF, REDDISH BROWN, CLAYEY SILT	15		5-C	-	33	-	-	-	4 4/5
	END OF BORING @ 15.5'									

* ELEVATION ESTIMATED FROM TOPO MAP

WALTER LUM ASSOCIATES

3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 777-931

Boring Log

PROJECT: WAIPAHU ESTATES SUBDIVISION UNIT 1

LOCATION: WAIPIO, EWA, OAHU, HAWAII

T.M.K.: 9-4-07: 9

HAMMER:

Weight: 10 LB. SLEDGE HAMMER

Drop:

SAMPLER: 2" STANDARD SPLIT SPOON

BORING NO. 5A Sheet No. ____ of ____

Driller: WALTER LUM ASSOC. Date: JAN. 17, 1969

Field Party: PA, MOENOA, SCHELLING

Type of Boring: AUGER (MOBILE MINUTEMAN) Diam.: 3"

Elev.: 53'± * Datum: -

Drill Bit: FINGER TYPE BIT

Water Level	NOT NOTICED			
Time	-			
Date	1-17-69			

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Elev.	Sample No.	Wet Dens. P.C.F.	Moist. Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: 2" STANARD SPLIT SPOON w/ 10# HAMMER, Blows Per Foot (0 10 20 30 40)
	ELEV. = 53'± * 2	0								
	BROWN, CLAYEY SILT w/ SUGAR CANE									
(MH)	MEDIUM, BROWN-GRAY SILTY CLAY	5		5A-A	-	42	-	-	-	7/5 4/5 4/5
(ML)	STIFF, REDDISH BROWN CLAYEY SILT	10		5A-B	-	37	-	-	-	17/5 26/5
	END OF BORING @ 11'									

*ELEVATION ESTIMATED FROM TOPO MAP.

WALTER LUM ASSOCIATES

3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 777-931

Boring Log

PROJECT: WAIPAHU ESTATES SUBDIVISION UNIT 1
LOCATION: WAIPIO, EWA, OAHU, HAWAII
T.M.K. : 9-4-07 : 9

HAMMER:
Weight: 140#
Drop: 30"
SAMPLER: 2"ST - 2" THIN WALL TUBE
2"SS - 2" STANDARD SPLIT SPOON

BORING NO. 12 Sheet No. ____ of ____
Driller: WALTER LUM ASSOC. Date: JAN. 15, 1969
Field Party: PA; MOENOA
Type of Boring: AUGER (MOBILE MINUTEMAN) Diam.: 3"
Elev.: 52' ± * Datum: —
Drill Bit: T.C. DRAG BIT
Water Level: NOT NOTICED
Time: —
Date: 1-15-69

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Elev.		Sample No.	Wet Dens. P.C.F.	Moist. Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: STANDARD PENETRATION TEST Blows Per Foot (0 10 20 30 40)	PENETRATION DATA: 2" THIN WALL TUBE SAMPLER BLOWS/0.5'
	ELEV. = 52' ± *	0										
(MH)	MEDIUM, REDDISH BROWN, SILTY CLAY		2"ST		12-A	116	36	85	2500	1200		3/5 2/5
(ML)	STIFF, BROWN CLAYEY SILT	5	2"SS		12-B	-	34	-	-	-		
(ML)	VERY STIFF, MOTTLED BROWN, CLAYEY SILT	10	2"SS		12-C	-	26	-	-	-		
(MH)	STIFF, BROWN SILTY CLAY	15	2"SS		12-D	-	35	-	-	-		
	END OF BORING @ 16.5'											

*ELEVATION ESTIMATED FROM TOPO MAP.

GENERAL TESTING METHODS

EXPLORATORY BORINGS AND SAMPLING

Method for soil investigation and sampling by auger borings (Tentative)	ASTM Designation: D 1452-63T
Method for thin wall tube sampling of soils (Tentative)	ASTM Designation: D 1587-63T
Method for penetration test and split barrel sampling of soils (Tentative)	ASTM Designation: D 1586-64T

LABORATORY TESTING

Grading Analysis

Sieve analysis of fine and coarse aggregates	AASHO Designation: T 27-60
Amount of material finer than No. 200 sieve in aggregate	AASHO Designation: T 11-60

Atterberg Limits

Determining the liquid limit of soils Modified as follows: Substitute Casagrande grooving tool. Tests conducted from natural moisture content unless noted otherwise.	AASHO Designation: T 89-60
Determining the plastic limit of soils	AASHO Designation: T 90-56
Calculating the plasticity index of soils	AASHO Designation: T 91-54

Specific Gravity

Specific gravity of soils Modified as follows: 500 ML Pycnometer	AASHO Designation: T 100-60

Expansion and CBR Tests

Expansion test and California Bearing Ratio (CBR)	Section VIII - TM 5-530 "Materials Testing" by Headquarters, Dept. of the Army

Compaction Test

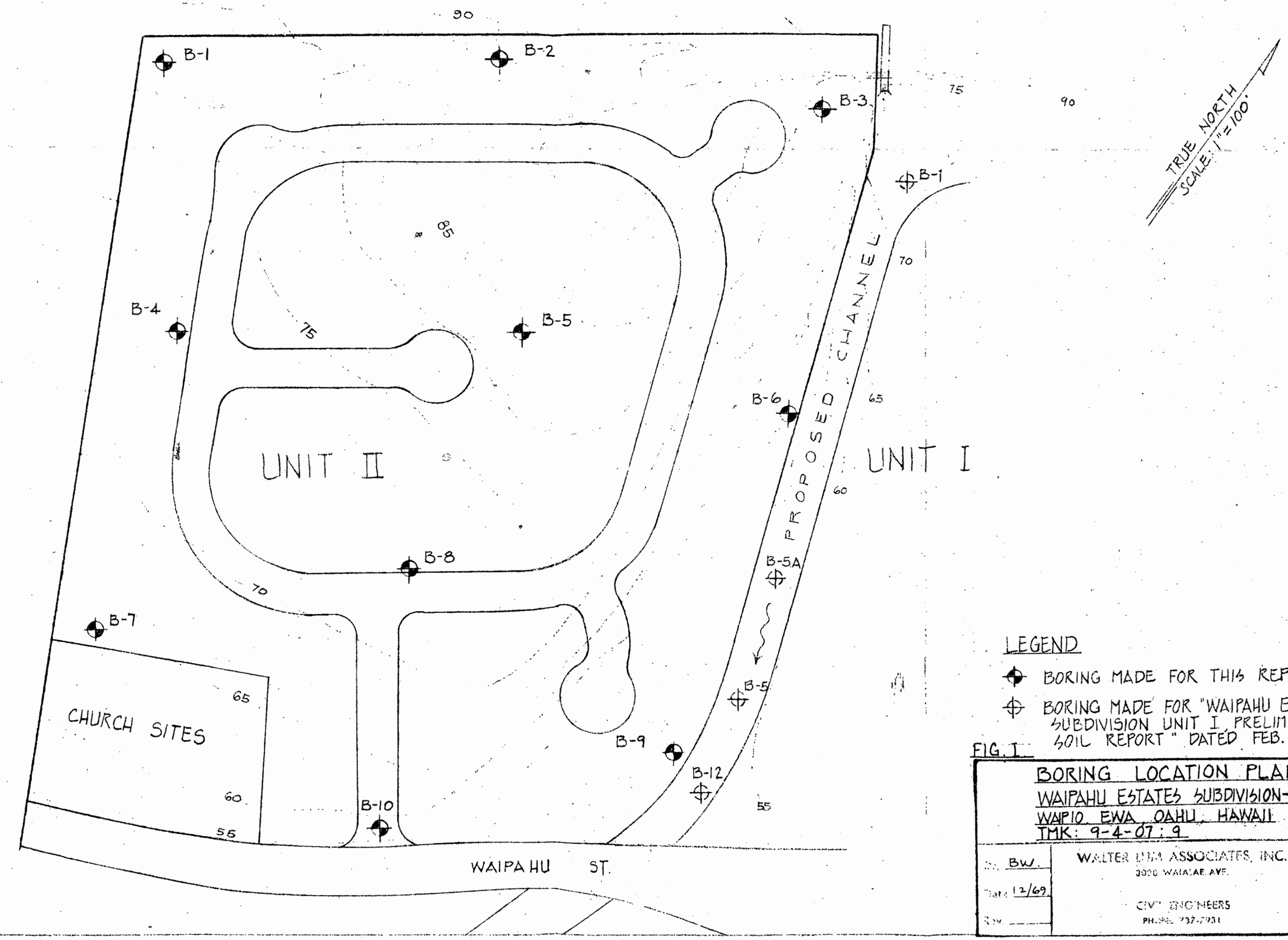
Moisture-Density relations of soils using a 10# rammer and an 18" drop	AASHO Designation: T 180-57

Unified Soil Classification

Designation E-3 from "Earth Manual" by the United States Department of the Interior Bureau of Reclamation

LIMITATIONS

In general, soil formations are commonly erratic and rarely uniform or regular. The borings indicate the subsurface soil conditions encountered only at the drill holes where the borings were made. During construction, should subsurface conditions much different from those in the borings be observed, encountered, or otherwise indicated, we should be advised immediately to review or reconsider our recommendations in light of the new developments. The owner, architect, or engineer should make certain that the recommendations are incorporated into the plans and are properly carried out during construction.



LEGEND

- BORING MADE FOR THIS REPORT
- BORING MADE FOR "WAIPAHU ESTATES SUBDIVISION UNIT I, PRELIMINARY SOIL REPORT" DATED FEB. 3, 1969.

FIG. I

BORING LOCATION PLAN
WAIPAHU ESTATES SUBDIVISION-II
WAIPIO EWA, OAHU, HAWAII
TMK: 9-4-07: 9

Dr. BW.	WALTER LUM ASSOCIATES, INC.	Sheet
Date 12/69	3000 WAIALAE AVE.	
Rev.	CIVIL ENGINEERS	of
	PHONE 737-7931	